

# PATENT SPECIFICATION

(11) 1 464 924

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- (21) Application No. 18715/74 (22) Filed 29 April 1974  
 (31) Convention Application No. 2354/73  
 (32) Filed 1 May 1973 in  
 (33) Denmark (DK)  
 (44) Complete Specification published 16 Feb. 1977  
 (51) INT CL<sup>2</sup> A23K 1/00  
 (52) Index at acceptance  
 A2B J3A3 J3C J3F2 J3G11 J3G3 J3G6 J3G7



## (54) A PIG FEED

(71) We, DANSK LANDBRUGS GROVVARESELSKAB, a Co-operative Society organised under the laws of Denmark, of Axelborg 3, DK-1503 Copenhagen V, Denmark, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a pig feed comprising vegetable and optionally animal fat and having a substantial content of linoleic acid.

For the feeding of slaughter pigs it is normal to use feeding stuffs with a high content of barley and other grains. The composition of the feeding stuffs is adjusted so as to produce the best possible meat and fat quality, that is to say the fat shall be of a firm consistency. Fat of a soft consistency is usually considered to be of poor quality and thus undesirable.

The fat quality is generally determined by ascertaining the iodine number of the fat, in that a poor quality fat has a particularly high iodine number corresponding to a high content of unsaturated fatty acids such as oleic acid, and linoleic acid.

To be considered of a satisfactory quality the fat of the slaughter pigs must have an iodine number between 60 and 65, preferably about 62.

By feeding experiments it has been tried to replace barley by various other grains, seeds or animal fat, and tests with maize, for instance, showed that the fat was of a poor quality because the iodine number was too high, that is above 65, on account of a high content of linoleic acid. Feeding with soybean oil or soybeans also results in soft fat of unsatisfactory consistency.

It has also been tried to use animal fat as a component of pig feed, but these experiments resulted in the production of poor quality fat owing to the high content of oleic acid with the consequent high iodine number.

For that reason it has not previously been possible to obtain good results with maize and similar linoleic acid-containing fats or animal fat as a component in pig feed.

In recent years the demand for foodstuffs with a high content of unsaturated fatty acids such as linoleic acid has been increasing because the unsaturated fatty acids are supposed to be active against the formation of cholesterol. It would therefore be desirable to be able to produce lard or fat having an increased content of linoleic acid without affecting the quality of the product.

It is the object of the present invention to produce fat and lard having an increased content of linoleic acid, without raising the iodine number, that is without causing the fat to be soft and of poor consistency.

This object has been accomplished by the pig feed according to the invention, which comprises vegetable and optionally animal fat with a substantial content of linoleic acid, and which is specific in that it further contains an amount of from 0.5—6 per cent by weight of coconut oil based on the total feed mixture, the amount being sufficient to result in lard or pig fat obtained by the slaughter of pigs fed on the feed having an iodine number of from 60 to 65.

The invention is based on the surprising discovery that minor amounts of coconut oil counteract the increase of the iodine number which would otherwise result when using a pig feed with a high content of linoleic acid-containing fats or animal fat. It has been found that the presence of coconut oil in the pig feed will reduce the content of oleic acid in the lard, whereas the content of linoleic acid in the lard will not be reduced. This is highly desirable since it is an advantage to obtain a lard with the highest possible content of linoleic acid without deterioration of the consistency, thus requiring that the content of oleic acid should be kept at a low level.

The amount of coconut oil to be employed will be dependent upon the amounts of linoleic acid and animal fat present in the feed. The greater the amount of linoleic acid and animal fat present, the greater the amount of coconut oil required. Such amounts may be determined by those skilled in the art. By way of example and guidance only, we have found that for feeds having a linoleic acid content in the range 1.6 to 1.7%, addition of 2% coconut

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oil lowers the iodine number of the back fat obtained from pigs fed with a comparable feed containing no coconut oil by only 0.6, whereas addition of 4% coconut oil results in a reduction of nearly 5 in the iodine number.

Thus it has been found that by means of the pig feed according to the invention it will be possible to obtain a lard with an increased content of linoleic acid without increasing the iodine number. This is a consequence of the simultaneous reduction of the content of oleic acid containing fat.

It has been found to be expedient to use

a pig feed in which the linoleic acid containing fats derive from maize, maize oil, soybeans and/or soybean oil.

To illustrate the invention in greater detail a series of feeding experiments carried out with different mixed feeds will be described below.

In one experiment were used four test mixtures: one check group of pigs was fed with barley, a second group with a feed containing maize and two groups with a feed containing maize to which was added respectively 2% and 4% of coconut oil. The following Table 1 shows the composition of the mixed feeds.

TABLE 1

Composition of mixed feeds used in the experiment.

Mixture	I (com- parative)	II (com- parative)	III (com- parative)	IV (of the invention)
Barley	78.0	24.0	18.0	12.0
Maize	—	50.0	50.0	50.0
Coconut oil	—	—	2.0	4.0
Soybean meal	18.0	22.0	26.0	30.0
Meat-and-bone meal	2.0	2.0	2.0	2.0
Mineral mix 2	1.8	1.8	1.8	1.8
Solivit 2000	0.2	0.2	0.2	0.2
In all	100.0	100.0	100.0	100.0

The mixtures were balanced so that the proportion between energy and protein was the same. The feeding was moderate and the rations of the four mixtures were weighed so that the same amount of energy and protein was administered per day to the four groups.

Groups II, III and IV comprised 12 pigs while the check group I comprised only 10

pigs. After slaughtering samples were drawn from the back fat of each pig. The test samples from the pigs in the same sty were collected into a composite sample so as to get two test samples from each group, and in these samples the iodine number and the composition of fatty acids were determined.

*Test Results.*

In Table 2 it has been tried to illustrate the test results.

TABLE 2

Growth and fodder consumption.

Test groups	I	II	III	IV
Number of pigs	10	12	12	12
Excluded	0	0	0	0
Initial average weight (kg)	23.5	23.6	23.9	23.4
Average weight at end of test (kg)	84.9	85.2	85.0	86.0
Number of feeding days	99	101	97	99
Daily growth (g)	622	610	627	631
Kgs fodder per feeding day per pig	1.76	1.62	1.53	1.47
Kgs fodder per pig	173	164	149	146
Kgs fodder/kgs growth	2.83	2.66	2.44	2.33
Ratio of pig fodder/kg growth compared with group I×100	100.0	94.0	86.2	82.3
Metabolizable energy per kg growth (kcal)	8431	8658	8154	8118
Feed units/kg growth (corrected metabolizable energy)	2.86	3.01	2.86	2.86
Fat quality				
Number of pigs in A1 extra	9*	8	7	9
Number of pigs in A1		4	5	3

\* One pig excluded.

- 5 It will be seen from the table that the growth was practically the same in the four groups and that the energy consumption (feed units per kg growth) was also practically the same.

*Composition of fatty acids*  
Table 3 shows in per cent the content of each of the fatty acids in the feed.

TABLE 3  
Percentage content of fatty acids in mixtures

Mixture	C <sub>8</sub>	C <sub>10</sub>	C <sub>12</sub>	C <sub>14</sub>	C <sub>16</sub>	C <sub>16</sub> -mono unsaturation (palmitoleic acid)	C <sub>18</sub>	C <sub>18</sub> -mono unsaturation (oleic acid)	C <sub>18</sub> -bis unsaturation (linoleic acid)	C <sub>18</sub> -ter unsaturation (linoleic acid)	Total
I	—	—	—	0.01	0.49	0.01	0.06	0.29	1.11	0.14	2.10
II	—	—	—	0.01	0.50	0.01	0.08	0.55	1.60	0.12	2.86
III	0.06	0.06	0.57	0.23	0.58	0.01	0.13	0.70	1.69	0.10	4.11
IV	0.24	0.20	1.82	0.64	0.79	0.02	0.19	0.86	1.67	0.10	6.54

It appears from the table that the content of linoleic acid is about 50% higher in the three mixtures containing maize. It will be seen from Table 4 that only the linoleic acid content of the pigs' fat is substantially affected by substituting maize for barley. Here the relative content of linoleic acid increased from 9.7% to 14.5%, while the corresponding decrease was distributed over the other fatty acids. The decrease of palmitoleic acid resulting from the substitution of maize for barley appears to be relatively greater than that of the other acids. On the addition of coconut

oil the content of linoleic acid remained constant though with a faint tendency to increase on account of the increased content in the feed deriving from the coconut oil. The content of oleic acid decreased. It will also be noted that the short-chain fatty acids, caprylic and capric acid, were converted or oxidized, while lauric acid was deposited in but small amounts despite the rather high content thereof in the two mixtures containing coconut oil.

Table 4 shows the relative content of fatty acid in the back fat.

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TABLE 4

Relative fatty acid composition in back fat.

Mixture	C <sub>12</sub>	C <sub>14</sub>	mono-unsaturated fatty acid	C <sub>16</sub>	Palmitoleic oleic acid	C <sub>18</sub>	oleic acid	linoleic acid	linoleic acid
I (Barley)	0.1	1.7	—	26.8	3.3	14.1	42.1	9.8	2.3
II (Maize)	0.1	1.5	—	25.6	2.8	13.4	40.2	14.5	2.2
III Maize+2% coconut oil	0.9	3.2	0.1	26.3	3.3	11.4	37.5	15.6	2.0
IV Maize+4% coconut oil	2.1	6.0	0.1	25.5	3.5	11.0	34.9	15.4	1.7

The analytical samples of the back fat were also analysed for determination of the iodine number. In the groups (II, III and IV) fed with maize the increase of the content of linoleic acid will raise the iodine number while the decrease of oleic acid in Groups III and

IV by feeding with coconut oil will pull in the opposite direction. There is also an increase of lauric acid and myristic acid.

Table 5 shows the iodine number in the back fat of the four groups.

TABLE 5

Iodine number of fat of the four experimental groups.

Mixture	I	II	III	IV
Iodine number	61.7	67.1	66.4	62.3

It will be seen that the addition of 4% of coconut oil was able to practically neutralise the increase of the iodine number caused by a 50% content of maize in a mixed feed.

In the following test were used mixed feeds containing barley with an addition of animal fat.

Four mixtures were used: a barley mix with 20% of protein-mixture; a mix with 2.5% of animal fat; a mix with 5% of animal fat; and a mix with 3% of animal fat+2% of coconut oil. The table exemplifies how animal fat and coconut oil can be combined in a mixed pig feed.

TABLE 6

Mixture	V	VI	VII	VII
Barley	78.0	72.5	66.0	66.0
Animal fat	—	2.5	5.0	3.0
Coconut oil	—	—	—	2.0
Soybean meal	18.0	21.0	25.0	25.0
Meat-and-bone meal	2.0	2.0	2.0	2.0
Mineral mix 2*	1.8	1.8	1.8	1.8
Solivit 2000**	0.2	0.2	0.2	0.2
In all	100.0	100.0	100.0	100.0
Feed units	100.3	105.8	111.6	112.6
Digestible pure protein/ Feed units (corrected metabolizable energy)(g)	149	149	150	149

\* Mineral mix 2:

41% dicalcium phosphate  
 33% calcium carbonate  
 20.8% sodium chloride  
 1.07% ferrosulphate  
 0.90% zinc oxide  
 0.60% manganese oxide  
 2.5% copper sulphate  
 0.06% cobalt sulphate  
 0.015% potassium iodide

\*\* Solivit 2000 per gram:

2,000 iu vitamin A  
 500 iu vitamin D<sub>3</sub>  
 5,000 mcg E  $\alpha$ -tocopherol acetate  
 1,500 mcg vitamin B<sub>2</sub>  
 4,000 mcg D-pantothenic acid  
 5 mcg vitamin B<sub>12</sub>  
 admixed in 30% wheat foddermeal  
 70% wheat bran (middlings)

## WHAT WE CLAIM IS:—

5 1. A pig feed comprising fat containing  
 10 linoleic acid, the fat being vegetable and  
 optionally animal fat, characterized in that it  
 further contains from 0.5 to 6 per cent by  
 weight of coconut oil based on the total feed  
 mixture, the amount being sufficient to result  
 in lard or pig fat obtained by slaughter of  
 pigs fed on the feed having an iodine number  
 of from 60 to 65.

15 2. A pig feed according to claim 1 character-  
 ized in that the linoleic acid containing fats  
 derive from maize, maize oil, soybeans and/or  
 soybean oil.

3. A pig feed according to claim 1 substan-  
 tially as specifically described herein.

4. Pig meat wherever obtained from  
 slaughtered pigs which have prior to slaughter  
 been fed on a feed according to any one of the  
 preceding claims.

5. Lard or pig fat obtained by the slaughter  
 of pigs fed on feeds according to any of claims  
 1 to 3 having a linoleic acid content of at  
 least 14.5% by weight based on the total  
 fatty acid content and an iodine number of  
 from 60 to 65.

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